U. S. FOREST SERVICE

RESEARCH NOTE NC-5

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

Folwell Avenue, St. Paul, Minnesota 55101

Performance of Seven Seed Sources of Blue Spruce in Central North Dakota

Blue spruce (*Picea pungens* Engelm.) has been planted quite extensively in North Dakota shelterbelts and farmstead windbreaks. Generally survival and growth have been promising, but there is considerable variation in the performance of individual trees or plantations. Poorly adapted seed sources have been suspected as one cause for poor performance. There should be interest, therefore, in the results of a study designed to test the growth, survival, and resistance to climatic agents of seven known seed sources of blue spruce after 5 years in the field.

The Study

Seed collections were assembled by Professor Donald Duncan of the University of Minnesota Forestry Department. The seedlings were produced in the nursery at the University of Minnesota Forest Research Center near Cloquet, and in 1958 were transferred as small 3-0, 4-0, and 5-0 stock to the Hugo Sauer Nursery at Rhinelander, Wis. Three years later, when the stock was ready for field planting, it was unusually small for its age, probably because of crowded conditions in the seedbed and some rust infection in the transplant bed.

The trees were planted May 8, 1961, on a level area in the Denbigh Experimental Forest in north-central North Dakota The soil there is a Valentine loamy sand and had been covered by a native grass sod. The site had been plowed and disked during the 1960 growing season and disked again just prior to planting.

The trees were set out 6 feet apart in a single row, which consisted of 25 replications of 7-tree blocks. Each block contained in random order one tree (a single-tree plot) of each seed source. The row was bordered on the west by a row of 2-0 Siberian peashrub (*Caragana arborescens* Lam.) and on the east by a row of green ash (*Fraxinus pennsylvanica* Marsh.).

The origins of all the seed sources are south of the planting site at Denbigh by 5° to 13° of latitude (250 to 850 miles) and west of the planting site by 5° to 12° of longitude (fig. 1). The elevation at Denbigh is 1,486 feet; the elevations of the sources (see table 1) vary from 6,000 to 9,000 feet.

Results

Survival for the period between the second and the fifth years[1] after planting varied among the seed sources from 22 percent for the Targhee National Forest source in Wyoming to 96 percent for the Ashley National Forest source (number 1834) from the north

[1] *A severe drought the first summer was primarily responsible for initial losses ranging from 8 to 76 percent. Dead trees were replaced, but there was not enough stock of all lots to permit complete replanting. Hence survivals discussed here are based on the number of trees alive in the spring of 1962, after replanting.*

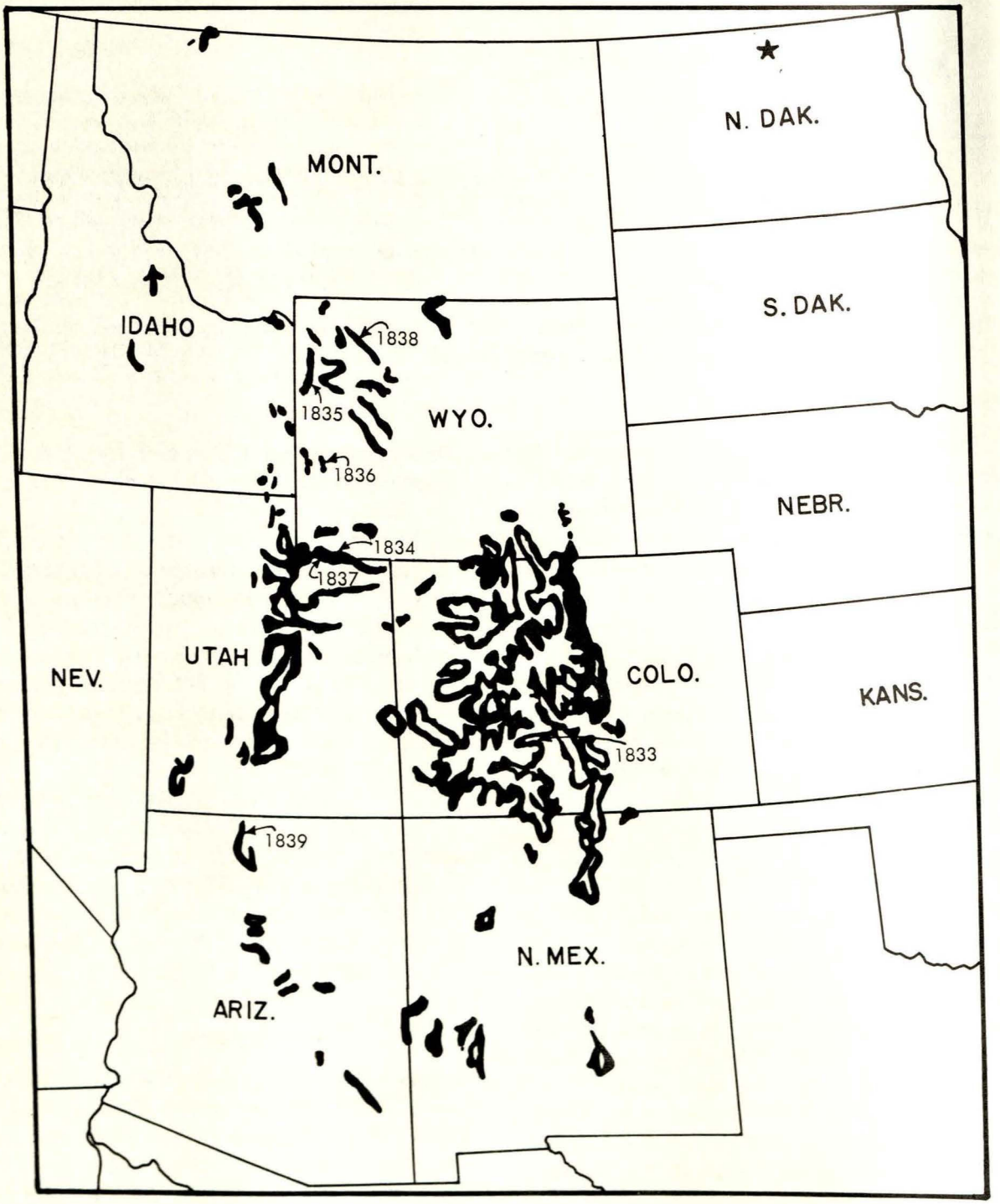

Figure 1.—Botanical range of blue spruce showing locations of the tested seed sources. (From Munns, E. N. The distribution of important forest trees of the United States. U.S. Dep. Agr. Public. 287, 176 pp., illus. 1938.)

Table 1.—Seed origin and 5-year results of seven sources of blue spruce growing in the Denbigh Experimental Forest, Denbigh, N. Dak.[1]

Source number	Source of seed: Class of stock May 1961	Source of seed: Location of native stand	Source of seed: Elevation of native stand	Five-year results: Survival (2-5 years)	Five-year results: 1965 age from seed	Five-year results: Mean height[2]	Five-year results: Average[3] frost damage in new growth 1964 & 1965	Five-year results: Average crown diameter
			Feet	Percent	Years	Feet		Feet
1834	5-3	Ashley Nat. Forest, Wyoming-Utah	7,000-7,500 (north slope)	96	13	1.88	1.9	1.1
1838	5-3	Shoshone Nat. Forest, Wyoming	8,000	69	13	1.77	2.2	.9
1835	5-3	Teton Nat. Forest, Wyoming	7,000	60	13	1.56	2.2	1.0
1833	3-3	Chaffee County, Colorado	8,000 +	72	11	1.46	2.2	.9
1836	5-3	Targhee Nat. Forest, Wyoming	6,000	22	13	1.40	2.5	.6
1839	4-3	Kaibab Nat. Forest, Arizona	9,000	52	12	1.32	2.3	.8
1837	5-3	Ashley Nat. Forest, Utah	7,000-8,000 (south slope)	68	13	1.23	2.0	.7

1/ The elevation of the planting site was 1,486 feet.

2/ Vertical bars bracket sources not significantly different in height according to Duncan's Multiple Range Test at the .05 level.

3/ Classification:

4 = Severe damage; more than 75% of shoots damaged.
3 = Medium damage; 25% to 75% of shoots damaged.
2 = Light damage; less than 25% of shoots damaged.
1 = No visible damage.

Shoot damage was scored according to the percentage of elongating buds on each tree blackened as a result of frost. The figure is an average for 1964 and 1965.

slope of the Uinta Mountain Range. The major causes of loss appeared to be drought and winter killing.

At the end of 5 years in the field, variation between average heights for the blue spruce lots was significant at the 5-percent level according to Duncan's Multiple Range Test.[2] Again the Ashley National Forest source (number 1834), from the northern mountain slopes was better than all other sources. Surprisingly, the source from the southern slopes of the Uinta Mountains in the Ashley National Forest (number 1837) had the shortest average height of the group.

Damage to new growth from severe late spring frosts occurring after flushing of buds was evaluated subjectively in 1964 and 1965 as severe, medium, light, or no damage. Although there appears to be but little correlation between susceptibility to late spring frost and other factors, the Ashley Forest source (1834) from the northern slopes of the mountains, was superior to others both in height growth and frost resistance.

There was also considerable variation in crown diameter, ranging from a low of 0.6 foot for the average of the Targhee National Forest source to almost twice as great (1.1 feet) for source number 1834 from the northern slopes of the mountains in the Ashley National Forest.

After 5 years in the field and on the basis of the four factors of survival, height, relative freedom from late spring frost damage, and crown diameter, it appears that the source from the north slopes of the Ashley

2 *Steel, Robert G. D., and Torrie, James H. Principles and procedures of statistics. 481 pp., illus. New York: McGraw Hill Book Co. 1960.*

National Forest is the best adapted to the test site of the seven sources planted. The fact that the shortest source (number 1837), from the southern slopes of the Uinta Mountains in the Ashley National Forest, has made only 65 percent of the height growth of the fastest growing source (1834), from the northern slopes of the range in the Ashley National Forest, indicates that seed source response data for blue spruce can be interpreted only for very limited—rather than broad—collection zones, when planting programs in the northern Prairie-Plains are being considered. We must remember, too, that the relative responses of the various seed sources may change as the plants become older.

DAVID H. DAWSON, *Plant Geneticist*[3]
Rocky Mountain Forest and Range Experiment Station
PAUL O. RUDOLF, *Principal Silviculturist*
North Central Forest Experiment Station

July 1966

[3] *When this study was made, Mr. Dawson was on the staff of the North Central Forest Experiment Station.*